

**MULTIPLE LINES OF EVIDENCE RISK ASSESSMENT  
OF GREAT BLUE HERON EXPOSED TO PCDD/DFs  
IN THE TITTABAWASSEE RIVER FLOODPLAIN,  
MIDLAND, MI, USA**

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# Contributors



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Department of  
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**ZOOLOGY**  
THE INTEGRATIVE STUDY OF ANIMAL BIOLOGY



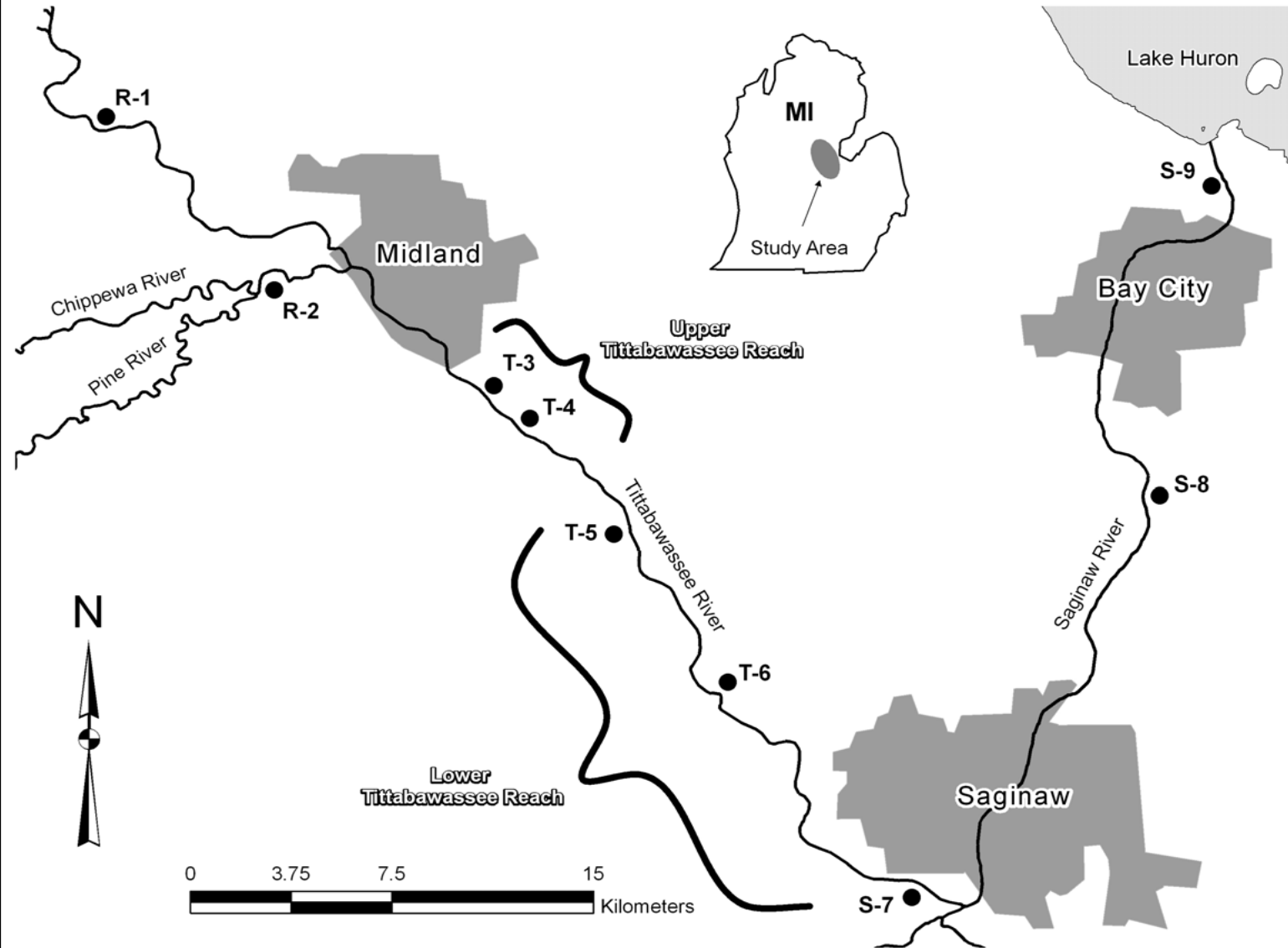
- Special thanks to...
  - Many field and laboratory technicians for their assistance
  - Local landowners, parks, and the Shiawassee National Wildlife Refuge for property access
  - The Dow Chemical Company for funding via an unrestricted grant

# Use as receptor species

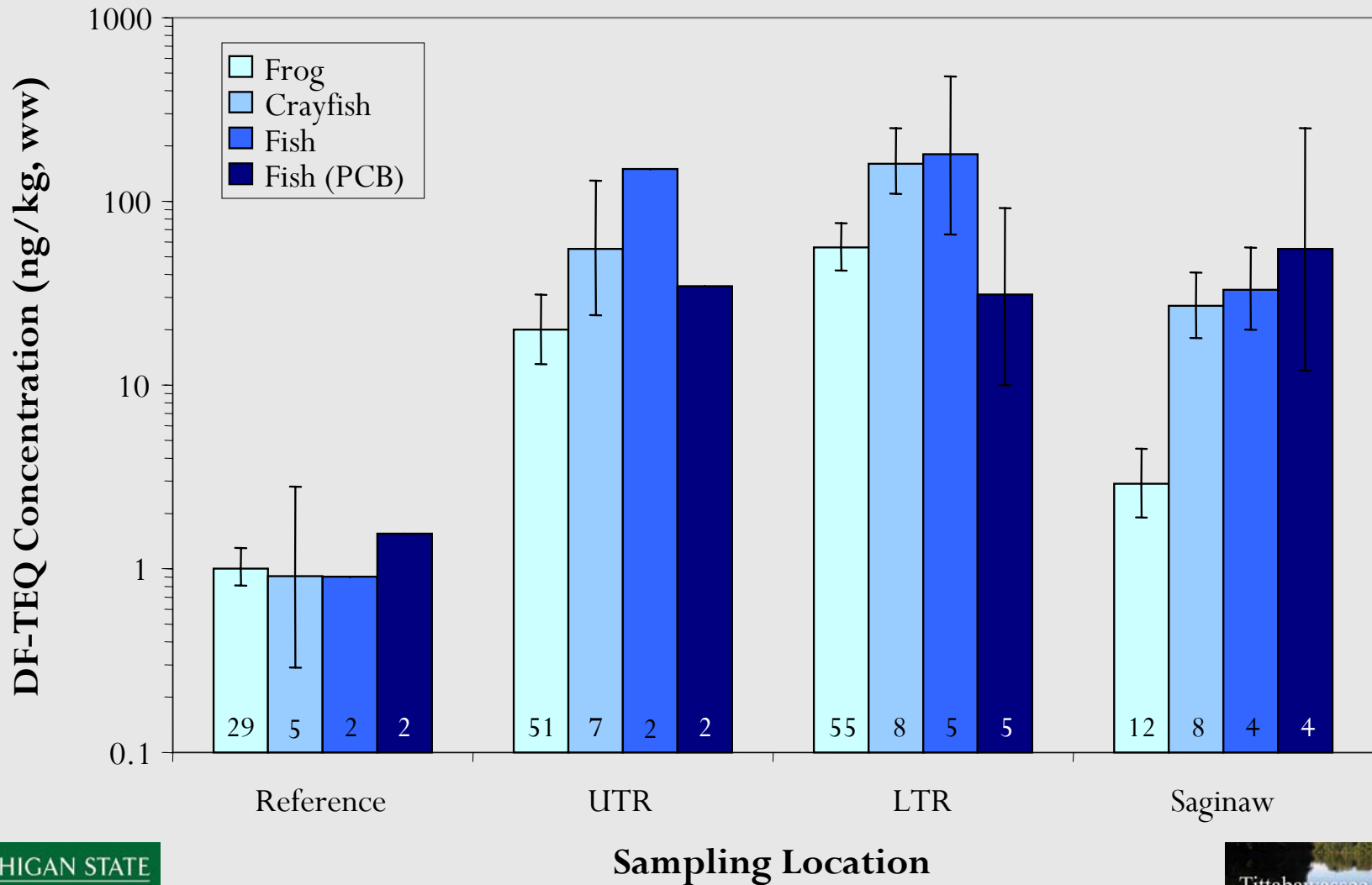


- Desirable characteristics
  - Territorial
  - High trophic status
  - Long-lived
  - Widespread distribution
  - Social importance
- Challenges
  - Nest access
  - Adult trapping
  - Potentially large foraging range

# Study area



# Dietary item concentrations



# Dietary exposure



Predicted daily dietary dose of DF-TEQs and total TEQs (ng/kg bw/d) for great blue heron breeding during 2004 – 2006 within the Chippewa and Tittabawassee river floodplains, based on geometric mean (95% confidence interval) of site-specific dietary items.

Study Area	DF-TEQs	Total TEQs*
Reference	0.17 (0.16–0.18)	0.44 (0.40–0.49)
Upper Tittabawassee	26 (23–31)	33 (29–38)
Lower Tittabawassee	33 (12–87)	38 (14–100)
Saginaw River	6.2 (3.5–13)	17 (5.4–51)

\* Total TEQs based on 100% fish diet due to missing PCB data for other taxa.

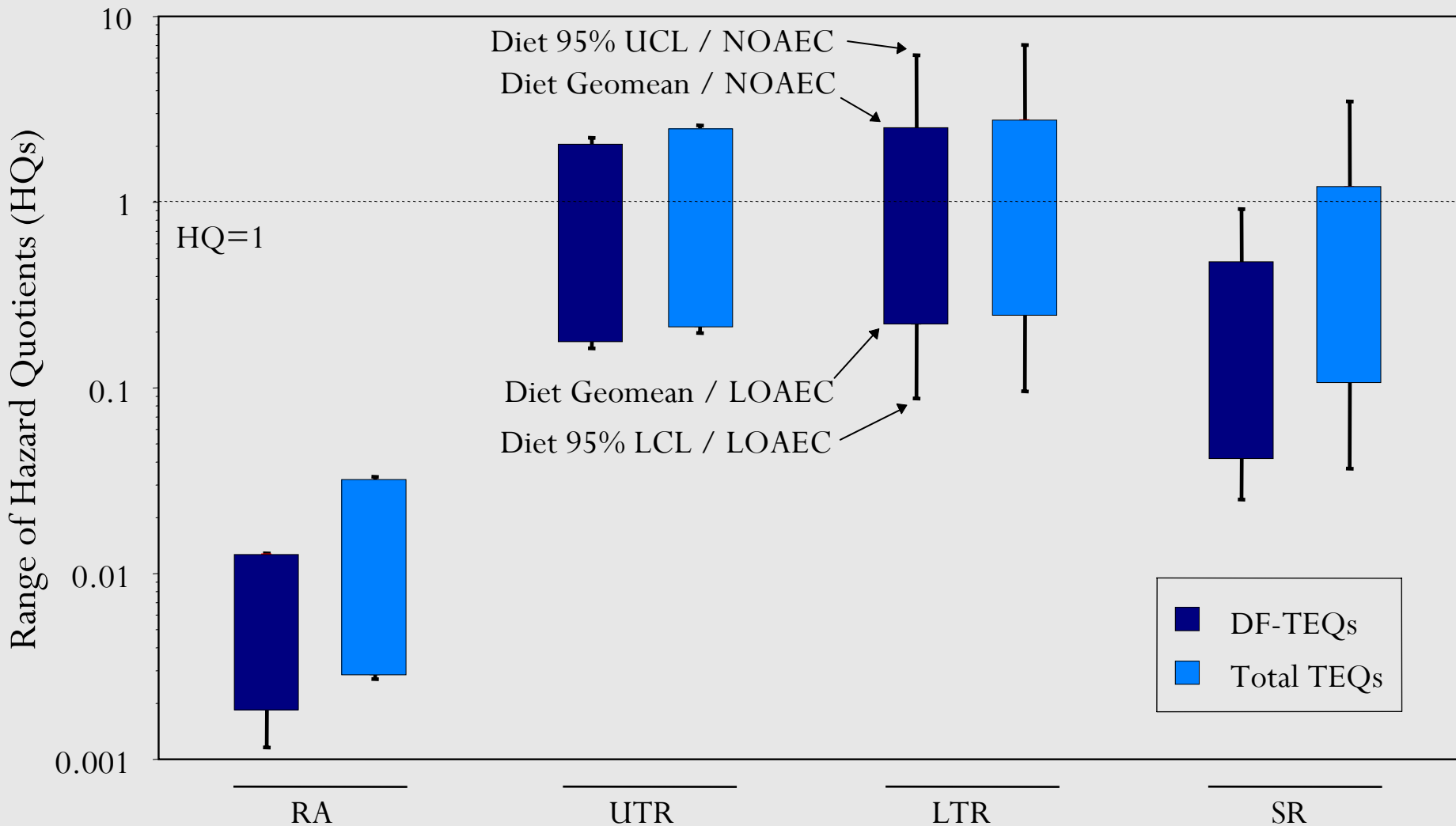
# Selected TRVs



- Dietary toxicity reference values (TRVs)
  - Based on ring-necked pheasant feeding study (Nosek 1992)
    - NOAEC: 14 ng TEQ/kg bw/d
    - LOAEC: 140 ng TEQ/kg bw/d
  - Nosek dietary TRVs are likely conservative for assessing risk to GBH
    - Dosing via IP injection as opposed to true dietary exposure
    - Based on molecular characteristics of ligand binding domain, the pheasant is more sensitive to dioxin-like compounds

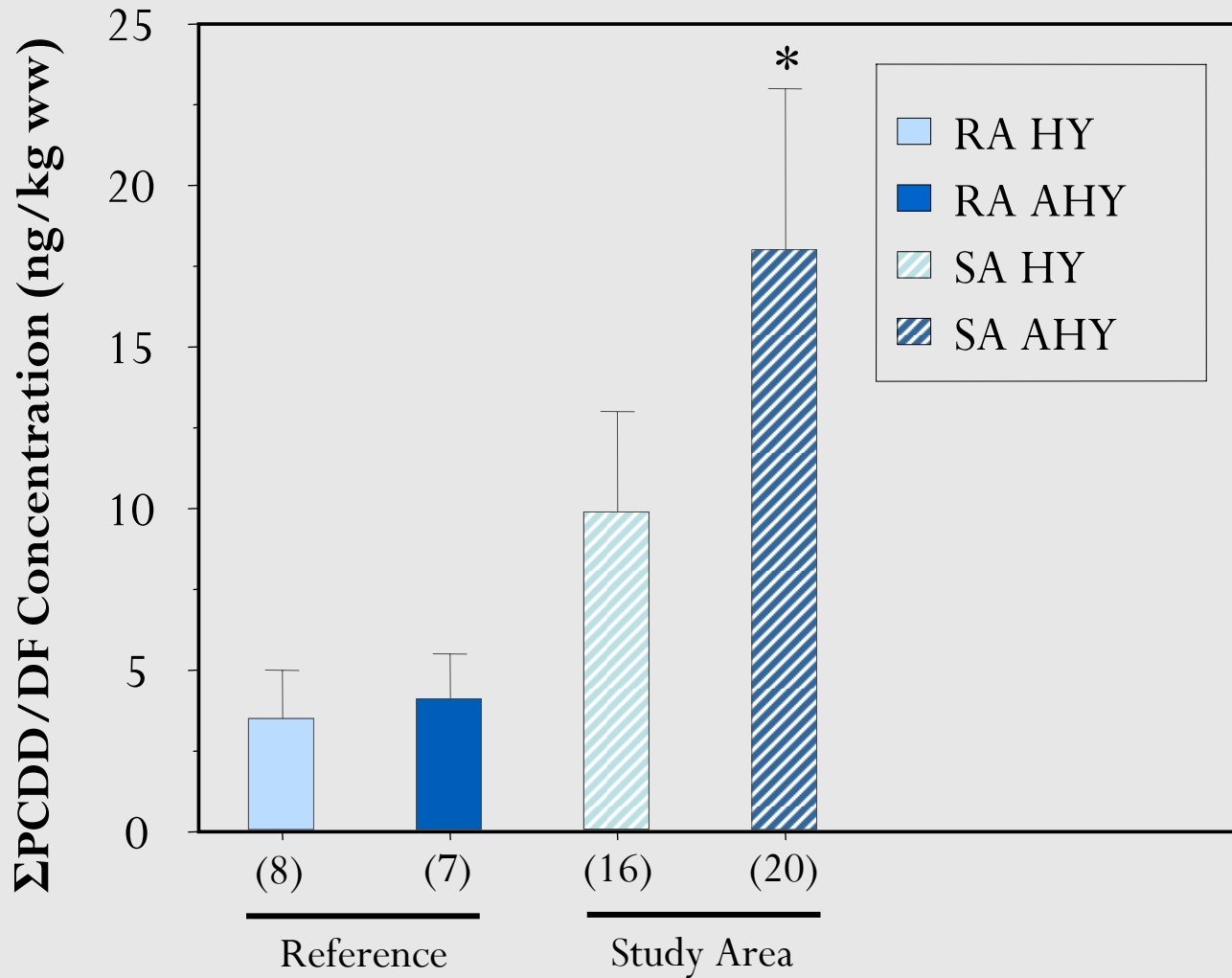


# GBH Dietary Exposure HQs

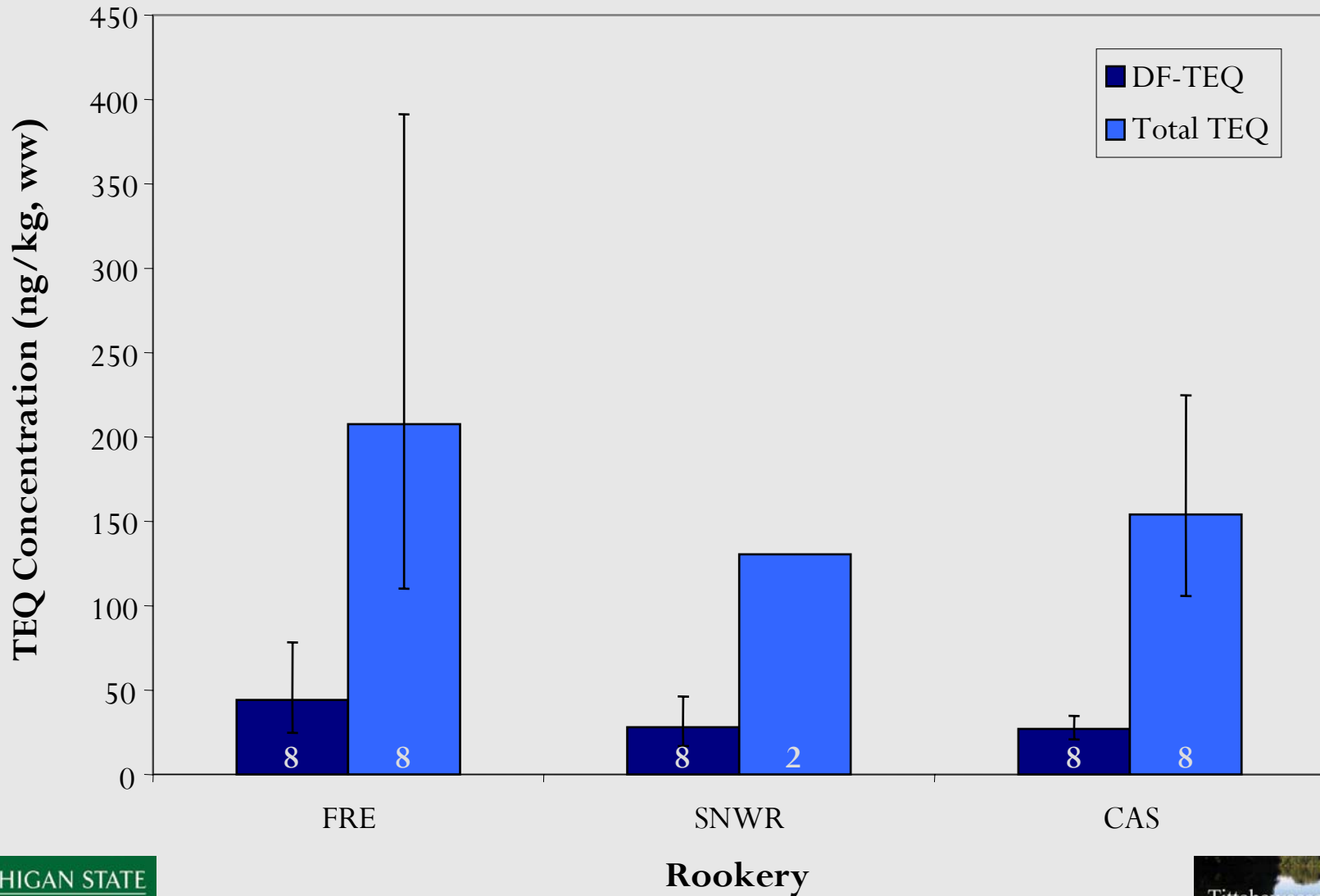




# GBH adult plasma



# GBH egg concentrations



# Selected TRVs



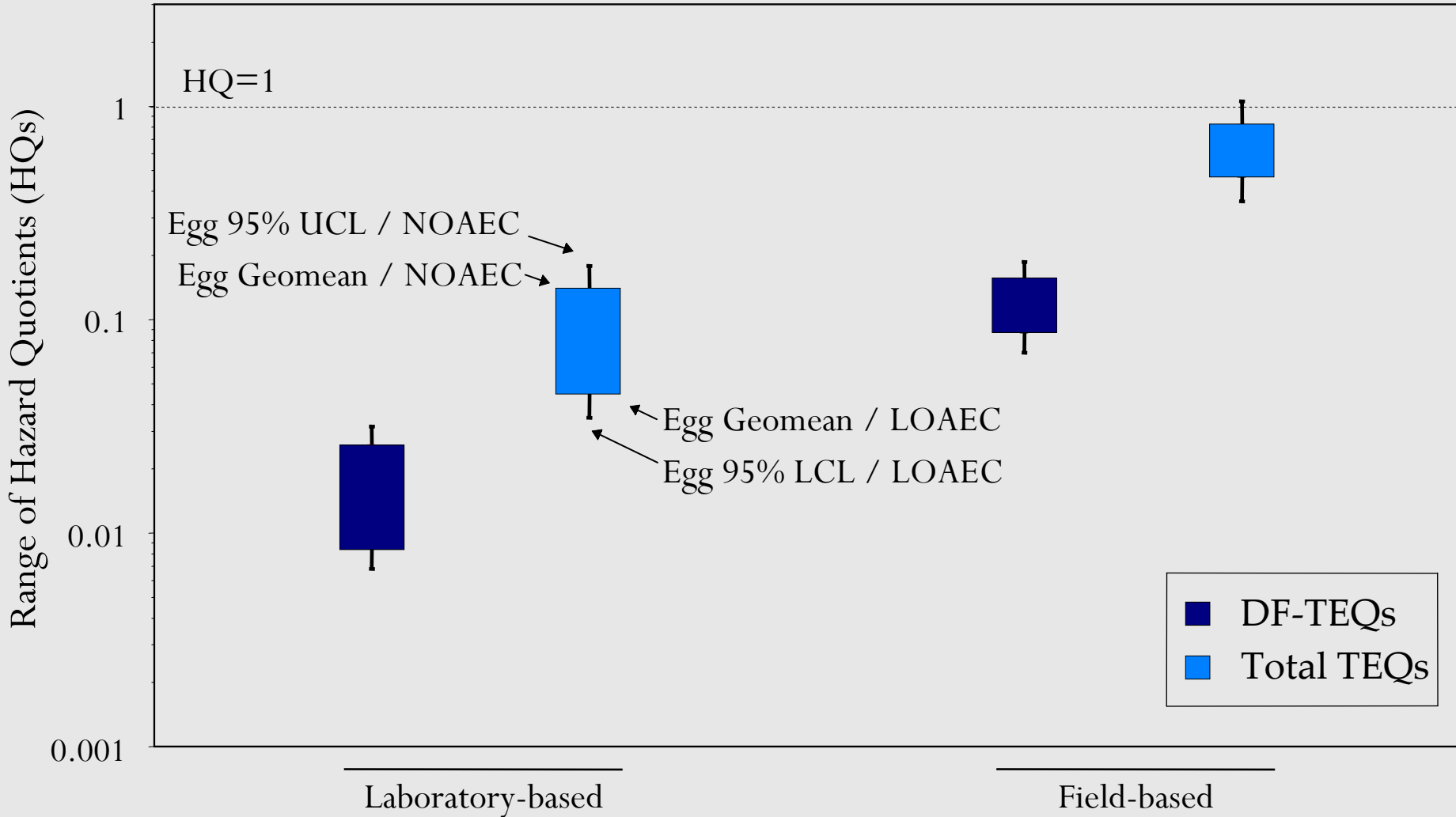
- Tissue-based toxicity reference values (TRVs)
  - Laboratory-derived: Based on double-crested cormorant egg injection studies (EPA 2003); applied an inter-species uncertainty factor (UF) of 3
    - NOAEC:  $3670 / 3 = 1300$  ng TEQ/kg
    - LOAEC:  $11090 / 3 = 3700$  ng TEQ/kg
  - Cormorant-derived egg TRVs are likely conservative values for assessing risk to GBH
    - Use of UF even though both species have similar ligand binding domain construct
    - Values derived from egg injection studies, which are likely not representative of true *in ovo* exposure

# Selected TRVs



- Tissue-based toxicity reference values (TRVs)
  - Field-derived: Based on GBH field studies
    - NOAEC: 220 ng TEQ/kg
    - LOAEC: 359 ng TEQ/kg
  - Consideration of field-derived values for assessing risk to GBH
    - Developed for same species
    - May be artificially lowered due to the presence of unconsidered co-contaminants
    - LOAEC based on observed chick health deficiencies, the ecological relevance of which was not established

# GBH Egg HQs



# Population condition



Reproductive effort of great blue heron nesting within the Tittabawassee River area during 2006-2007. Values presented as arithmetic mean  $\pm$  SD (n).

	FRE	SNWR	CAS
Clutch Size	3.8 $\pm$ 1.0 (22)	4.0 $\pm$ 1.6 (9)	3.9 $\pm$ 1.4 (23)
Nestlings/nest	2.7 $\pm$ 0.86 (21)	2.5 $\pm$ 1.1 (13)	3.4 $\pm$ 2.1 (8)

Nestlings/nest = number of chicks present at 4-5 weeks of age.

Both clutch size and the number of nestlings per successful nest are similar among rookeries and consistent with values found in the literature

# Conclusions



- HQs are at or below 1.0 based on the 95% UCL of total TEQ concentrations in eggs and field-derived TRVs
- Dietary HQs did exceed 1.0 when geometric mean of dietary items was compared to NOAEL, in contrast to egg-based HQs
- Dietary HQs are likely more conservative than egg-based HQs:
  - Assumption of 100% site-use is overly conservative
- Reproductive parameters measured here are similar to literature values



# Conclusions



Site-specific dietary- and tissue-based assessments suggest that great blue heron nesting within the Tittabawassee River floodplain are not likely to experience population level adverse effects from exposure to PCDD/DFs.

Direct measures of reproductive parameters support this conclusion.

# Other presentations...



- Multiple lines of evidence risk assessment for belted kingfisher exposed to PCDD/DF in the Tittabawassee River floodplain, Midland, MI USA
- A site-specific, multiple lines of evidence risk assessment of great horned owl (*Bubo virginianus*) exposure to PCDD/DFs in the Tittabawassee River floodplain in Midland, MI USA
- Assessing the exposure and condition of American robins along the Tittabawassee River using a multiple lines of evidence approach
- Adult and nestling band returns and long-term survival monitoring of three passerine species inhabiting the Tittabawassee River basin
- Concentrations of PCDDs and PCDFs in eggs and diets of wood ducks and hooded mergansers



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